★NSMO X22 98-409951/35 ★JP 10169526-A

In-cylinder injection spark ignition engine - has heater which operates during coldmachine starting, for heating fuel injection valve

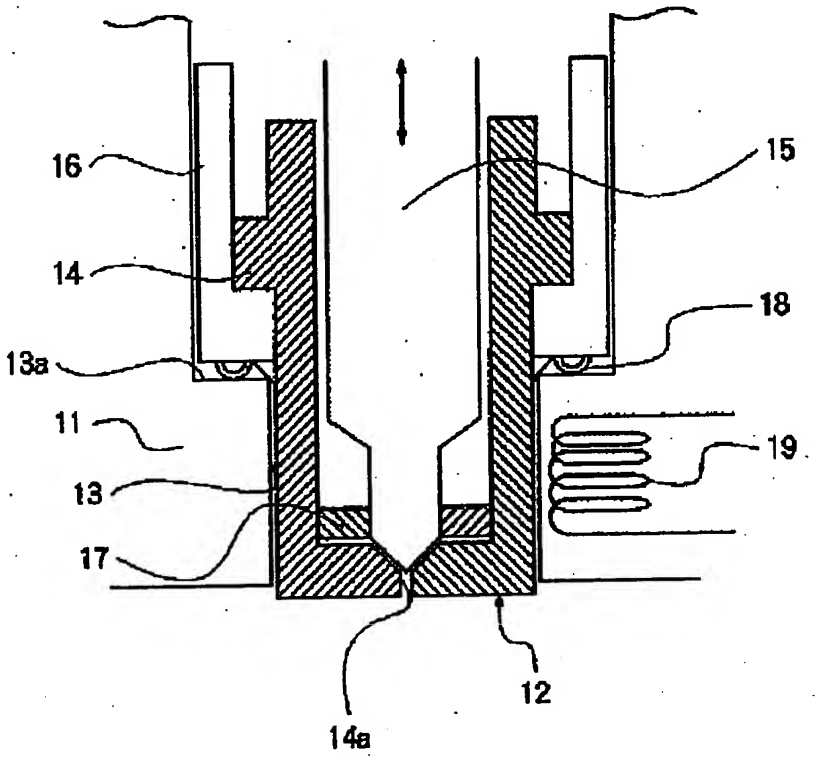
NISSAN MOTOR CO LTD 96.12.05 96JP-340547

Q53 (98.06.23) F02M 53/04, 31/12, 31/125

The engine has a fuel injection valve (12) attached to a cylinder head (11) forming a combustion chamber. Fuel is directly injected into this chamber. A heater (19) which operates during coldmachine start, is provided to heat the fuel injection valve.

ADVANTAGE - Prevents degradation of injection characteristic. Improves combustion stability. Discharges poisonous unburned gases, reliably. Reduces noise generation. (8pp Dwg.No.1/9)

N98-320079 X22-A02A X22-A02B



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3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the direct cylinder-injection-of-fuel formula spark-ignition engine which attaches a fuel injection valve in the cylinder head, and becomes it at a combustion chamber that direct fuel should be injected.
[0002]
[Description of the Prior Art] As a conventional direct cylinder-injection-of-fuel formula spark-ignition engine, what was indicated by JP,6-207542,A is known, for example. The outline composition is explained with reference to drawing 8 .
[0003] In this drawing, 31 is a cylinder block and is fitted in the interior of a cylinder block 31 free [sliding of a piston 32]. Crevice 32a is formed in a part of crestal plane (top face) of a piston 32. The cylinder head 33 is attached in the upper part of a cylinder block 31.
[0004] An ignition plug 34 is attached in the outline center section, and the exhaust air passage 36 which has the inhalation-of-air passage 35 and exhaust valve 36a which have inlet-valve 35a in the position of the outside of an ignition plug 34 is formed in the cylinder head 33. Outside, the fuel injection valve 37 is attached at the pan of the inhalation-of-air passage 35 of the cylinder head 33. A fuel injection valve 37 injects fuel directly into the combustion chamber formed by the inside of a cylinder block 31, the crestal plane of a piston 32, and the inside of the cylinder head 33.
[0005] By adopting such composition, by injecting fuel towards crevice 32a of the crestal plane of a piston 32 in the compression stroke last stage from a fuel injection valve 37 at the time of operation on low load conditions, a combustible gas mixture is formed only in the field to which the circumference of an ignition plug 34 was restricted, and lean combustion is realized.
[0006] In order to make the suitable combustible gas mixture only for the field to which the circumference of an ignition plug 34 was restricted form, the fuel oil consumption of a fuel injection valve 37 and the accuracy of spraying structure (spraying configuration) are required. For this reason, the point of a fuel injection valve 37 (the near is included.) It is below the same. It is constituted by two or more parts so that a process tolerance can be made high.
[0007] That is, the point of a fuel injection valve 37 consists of two or more parts, such as a fuel revolution element which makes it circle in the injection fuel prepared inside this injection tip of the nozzle parts with which the plunger which opens and closes this injection tip was inserted, the nozzle acceptance parts which receive these nozzle parts, and these nozzle parts, while having an injection tip.
[0008] Moreover, in case a fuel injection valve 37 is attached in the cylinder head 33, it is made to prevent that infix the gas-seal member which has a gas-seal function between a fuel injection valve 37 and the cylinder head 33, pass the fuel injection valve attachment mouth of the cylinder head 32 from a combustion chamber, and gas is revealed.
[0009]
[Problem(s) to be Solved by the Invention] However, if it is in the conventional direct cylinder-injection-of-fuel formula spark-ignition engine mentioned above Since temperature management of the point of the fuel injection valve constituted with two or more parts cannot be performed, Under a large low temperature service (for example, outside-air-temperature:-10 degree-C--20 degree C), the temperature gradient besides the combustion chamber at the time of cold machine starting When the heat deformation (coefficient of thermal expansion) of each part article which constitutes the point of a fuel injection valve differed, dispersion was produced in the injection property of fuel

and there was a trouble that combustion stability got worse as the result.
[0010] With reference to the concrete data furthermore shown in drawing 9 , it explains in detail. Drawing 9 is a graph which shows a direct cylinder-injection-of-fuel engine's property in contrast with the injection engine in a port. Here, a horizontal axis is engine temperature (degree C), and the vertical axis shows the amount of firing-pressure change in the cylinder in which an engine's combustion stability is shown (sigmaPi).
[0011] Since the heat deformation of each part article which constitutes the point of a fuel injection valve by the temperature gradient of the point of a fuel injection valve and a combustion chamber becoming large becomes less uniform [a direct cylinder-injection-of-fuel engine] as shown in this drawing when engine temperature becomes low temperature from -20 degrees C, Since the relative physical relationship of a plunger (needle valve) and a fuel-injection mouth varies and the dispersion width of face of injection properties, such as fuel oil consumption and spraying structure (spraying configuration), becomes large, cylinder internal pressure change becomes large rapidly, and combustion stability gets worse.
[0012] When combustion stability gets worse, not to mention unit power declining, noise is made to increase and there is also a possibility that a unburnt gas may be discharged further.
[0013] this invention is made in view of such a point, and aims at offering the direct cylinder-injection-of-fuel formula spark-ignition engine excellent in the injection property of the fuel at the time of cold machine starting, and combustion stability.
[0014]
[Means for Solving the Problem] In order to attain the purpose mentioned above, in the direct cylinder-injection-of-fuel formula spark-ignition engine which attaches a fuel injection valve in the cylinder head, and becomes it at a combustion chamber that direct fuel should be injected, the direct cylinder-injection-of-fuel formula spark-ignition engine of this invention according to claim 1 establishes a heater means to heat the aforementioned fuel injection valve, and is characterized by making it operate this heater means at the time of cold machine starting.
[0015] According to the direct cylinder-injection-of-fuel formula spark-ignition engine of this invention according to claim 1, since a fuel injection valve is heated by the heater means at the time of cold machine starting and it was made to raise the temperature of a fuel injection valve, the temperature gradient of the fuel injection valve and combustion chamber at the time of cold machine starting can be made small, and heat deformation of each part article which constitutes a fuel injection valve can be made small.
[0016] Therefore, degradation of the injection property accompanying heat deformation of each part article is prevented, and the combustion stability at the time of cold machine starting can be improved. Moreover, since not only the fuel injection valve itself but the fuel of the interior will be heated indirectly, the fluidity of the fuel at the time of cold machine starting becomes good and the atomization of spraying is promoted, a heater means can also aim at improvement in the injection property by this.
[0017] The direct cylinder-injection-of-fuel formula spark-ignition engine of this invention according to claim 2 is characterized by being laid under the aforementioned cylinder head by the aforementioned heater means in a direct cylinder-injection-of-fuel formula spark-ignition engine according to claim 1.
[0018] The installation of the heater means of a direct cylinder-injection-of-fuel formula spark-ignition engine according to claim 1 will be pinpointed concretely, and a fuel injection valve will be heated through this cylinder head by the heater means laid under the cylinder head in this case.
[0019] The direct cylinder-injection-of-fuel formula spark-ignition engine of this invention according to claim 3 is characterized by building the aforementioned heater means in the aforementioned fuel injection valve in a direct cylinder-injection-of-fuel formula spark-ignition engine according to claim 1.
[0020] The installation of the heater means of a direct cylinder-injection-of-fuel formula spark-ignition engine according to claim 1 will be pinpointed concretely, and a fuel injection valve will be directly heated by the heater means built in this fuel injection valve in this case.
[0021] According to the direct cylinder-injection-of-fuel formula spark-ignition engine of this

invention according to claim 4, in a direct cylinder-injection-of-fuel formula spark-ignition engine according to claim 1, the aforementioned heater means is characterized by being built in the seal member for gas disclosure prevention infixed between the aforementioned fuel injection valve and the aforementioned cylinder head.
[0022] the installation of the heater means of a direct cylinder-injection-of-fuel formula spark-ignition engine according to claim 1 is pinpointed concretely, and a fuel injection valve is boiled by the heater means built in the seal member for gas disclosure prevention infixed between this fuel injection valve and the cylinder head, and is heated
[0023] according to the direct cylinder-injection-of-fuel formula spark-ignition engine of this this invention according to claim 4 -- the improvement in combustion stability -- in addition, the conventional direct cylinder-injection-of-fuel formula spark-ignition engine -- receiving -- a seal -- since it can respond only by exchange of a member, a large design change is not needed for other portions and the number of parts does not increase, either, elevation of cost can be suppressed to the minimum
[0024]
[Effect of the Invention] According to the direct cylinder-injection-of-fuel formula spark-ignition engine of this invention according to claim 1 to 3, degradation of the injection property accompanying heat deformation of each part article which constitutes a fuel injection valve is prevented, and it is effective in the ability to improve the combustion stability at the time of cold machine starting. Moreover, since the fuel in a fuel injection valve will also be heated indirectly, it is effective in the ability to also aim at improvement in the injection property by this. Therefore, the fall of unit power, the increase in noise, and extensive eccrisis of a still more poisonous unburnt gas can be prevented.
[0025] Moreover, according to the direct cylinder-injection-of-fuel formula spark-ignition engine of this invention according to claim 4, in addition to the above-mentioned effect, it is effective in the ability to suppress elevation of cost to the minimum.
[0026]
[Embodiments of the Invention] Hereafter, the operation gestalt of this invention is explained in detail with reference to a drawing. Drawing 1 or drawing 5 is drawing for explaining the direct cylinder-injection-of-fuel formula spark-ignition engine concerning the 1st operation gestalt of this invention. First, the cross section showing the important section composition of drawing 1 is referred to.
[0027] In drawing 1 , 11 is the cylinder head, and although the cylinder head 11 is omitting illustration, it is being fixed to the upper part of the cylinder block with which the piston by which the crevice was formed in a part of the crestal plane (top face) was fitted in.
[0028] Moreover, although illustration is omitted at the cylinder head 11, an ignition plug is attached in the outline center section, and the exhaust air passage which has the inhalation-of-air passage and the exhaust valve which have an inlet valve is formed in the position of the outside of an ignition plug. Outside, the fuel injection valve 12 which injects fuel directly into the combustion chamber of the inhalation-of-air passage of the cylinder head 11 formed by the inside of a cylinder block, the crestal plane of a piston, and the inside of the cylinder head 11 is arranged further.
[0029] The attaching hole 13 in which a fuel injection valve 12 is attached and to penetrate is formed in the cylinder head 11, and the combustion chamber side (it is the bottom all over this drawing) of this attaching hole 13 is the hole where the cross section in which level difference side 13a was formed by forming this and an opposite side (it being the bottom all over this drawing) in a large diameter is circular in a narrow diameter as shown in drawing 1 .
[0030] The point of a fuel injection valve 12 (the near is included.) It is below the same. Since high degree of accuracy is required in order to make the suitable combustible gas mixture only for the field to which the circumference of an ignition plug was restricted by cooperation with the crevice of the crestal plane of a piston form, it is constituted by two or more parts. namely, the point of a fuel injection valve 12 -- the nozzle parts 14, a plunger (needle valve) 15, the nozzle acceptance parts 16, the fuel revolution element 17, and a gas seal -- a member -- it has the 18th grade and is constituted

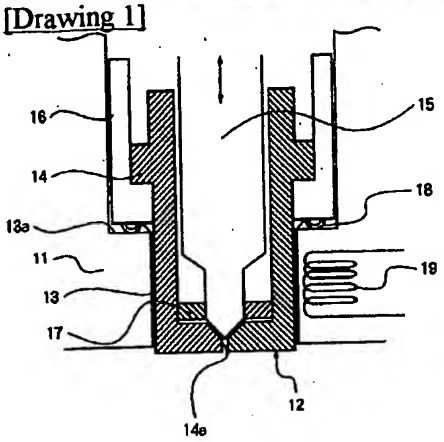
[0031] The nozzle parts 14 are the members formed in the shape of an outline cylinder, and they have the flange jutted out outside at the interstitial segment while they have fuel-injection mouth 14a in the combustion chamber side edge section. The inside portion of fuel-injection mouth 14a of the nozzle parts 14 is formed in the shape of a taper. The ring-like fuel revolution element 17 is arranged at the inside of the combustion chamber side edge section of the nozzle parts 14 so that it may be located in the circumference of fuel-injection mouth 14a. The fuel revolution element 17 has two or more slot 17a, and at the time of fuel injection, fuel circles and it is injected by operation of such slot 17a from fuel-injection mouth 14a as shown in drawing 2 .
[0032] The plunger 15 is arranged inside the nozzle parts 14. A nose of cam is the member of the shape of an outline pillar formed in the shape of a taper taper, and a plunger 15 opens and closes fuel-injection mouth 14a by being slid in the direction in alignment with the axial center. In addition, you may form the nose of cam of a plunger 15 in the shape of a ball.
[0033] The nozzle acceptance parts 16 are the members of the shape of an outline cylinder which has a through hole in the combustion chamber side edge section. While the nozzle parts 14 insert and fit in from the inside at this through hole of the nozzle acceptance parts 16 and the combustion chamber side edge section of the nozzle parts 14 and its near project from the nozzle acceptance parts 16 After the inside of the combustion chamber side edge section of the nozzle acceptance parts 16 and the flange of the nozzle parts 14 have contacted, the nozzle parts 14 are being fixed to the nozzle acceptance parts 16 in one.
[0034] Thus, the constituted fuel injection valve 12 is in the state where the combustion chamber side edge section of the nozzle parts 14 and its near were inserted in the thin diameter section of the attaching hole 13 of the cylinder head 11, and the nozzle acceptance parts 16 were inserted in the large diameter section of the attaching hole 13 of the cylinder head 11, and is being fixed to the cylinder head 11.
[0035] the gas seal of the shape of a ring for preventing disclosure of the gas from a combustion chamber between the circumference of the through hole of the combustion chamber side edge side of the nozzle acceptance parts 16, and level difference side 13a of the attaching hole 13 of the cylinder head 11 -- the member 18 is infixed
[0036] Near the thin diameter section of the attaching hole 13 of the cylinder head 11, the heater 19 which consists of heating wire which generates heat by energization is laid underground. Its ON/OFF (ON/OFF) is alternatively controlled by the heater control circuit as this heater 19 indicated to be to drawing 3 .
[0037] The heater control circuit is equipped with the control unit 23 which controls supply or interception of the power supply to the heater 19 by the relay circuit 22 and relay circuit 22 which were infixed in the middle of the heater wiring 21 connected to the dc-battery 20, and the heater wiring 21 according to the signal from various kinds of sensors.
[0038] A control unit 23 controls ON or OFF of a relay circuit 22 based on the signal from the sensor which detects the temperature near the point of a fuel injection valve 12 if needed [of detecting the water temperature of the sensor which detects oil temperatures, such as a lubricating oil, or a radiator / the signal and if needed] from a sensor.
[0039] It explains with reference to the flow chart which shows control by the control unit 23 to drawing 4 . This flow chart shows the processing in the case of controlling ON or OFF of a heater 19 based on an oil temperature or water temperature.
[0040] First, if an ignition switch is turned ON (ON) (1 "is displayed as ST a view"), [step] It is judged whether an oil temperature or water temperature is 0 degree C or less (Step 2), and when it is truth (T) (i.e., when an oil temperature or water temperature is 0 degree C or less) The relay-on signal which directs to perform energization to a heater 19 to a relay circuit 22 is sent, and, thereby, energization is started by the heater 19 (Step 3). Subsequently, it is judged whether the predetermined time T (second) set up beforehand passed (Step 4), and when it is a false (F) (i.e., when predetermined time has not passed), a state as it is is maintained.
[0041] In Step 4, when it passes in truth (T) (i.e., predetermined time), the relay-off signal which directs to stop the energization to a heater 19 to a relay circuit 22 is sent, the energization to a heater 19 is intercepted by this, and heating is ended (Step 5). Subsequently, cranking (fuel

injection) is started (Step 6). In Step 2, when it is a false (F) (i.e., when an oil temperature or water temperature is 0 degrees C or more), cranking is started immediately (Step 6).
[0042] In addition, time required to fully raise temperature near the point of a fuel injection valve 12 (for example, 0 degrees C or more) is found by experiment etc., and the aforementioned predetermined time T is set up beforehand.
[0043] It explains with reference to the flow chart which shows other control by the control unit 23 to drawing 5 . This flow chart shows the processing in the case of controlling ON or OFF of a heater based on the temperature an oil temperature or water temperature, and near the point of a fuel injection valve.
[0044] First, if an ignition switch is turned ON (ON) (1 "is displayed as ST a view"), [step] It is judged whether an oil temperature or water temperature is 0 degree C or less (Step 2), and when it is truth (T) (i.e., when an oil temperature or water temperature is 0 degree C or less) The relay-on signal which directs to perform energization to a heater 19 to a relay circuit 22 is sent, and, thereby, energization is started by the heater 19 (Step 3). Subsequently, it is judged whether the temperature near the point of a fuel injection valve 12 is 0 degree C or less (Step 4), and when it is a false (F) (i.e., when the temperature near the point of a fuel injection valve 12 is 0 degree C or less), a state as it is is maintained.
[0045] In Step 4, when the temperature the case of truth (T), i.e., near the point of a fuel injection valve 12, is 0 degrees C or more, the relay-off signal which directs to stop the energization to a heater 19 to a relay circuit 22 is sent, the energization to a heater 19 is intercepted by this, and heating is ended (Step 5). Subsequently, cranking (fuel injection) is started (Step 6). In Step 2, when it is a false (F) (i.e., when an oil temperature or water temperature is 0 degrees C or more), cranking is started immediately (Step 6).
[0046] Since according to the 1st operation gestalt of this invention mentioned above engine temperature heated the point of a fuel injection valve 12 at the heater 19 (when an oil temperature or water temperature is 0 degree C or less), makes the heat deformation of each part article which constitutes the point of a fuel injection valve 12 turn uniformly and suppresses expansion of the dispersion width of face of an injection property to a low case, the combustion stability at the time of cold machine starting can be improved.
[0047] That is, by the temperature gradient of the point of a fuel injection valve 12 and a combustion chamber becoming small, and the heat deformation of each part article which constitutes the point of a fuel injection valve 12 turning uniformly, for example, keeping suitable the relative physical relationship of the nose of cam of a plunger (needle valve) 15, and fuel-injection mouth 14a, injection properties, such as fuel oil consumption and spraying structure (spraying configuration), are stabilized, cylinder internal pressure change as shown in drawing 9 becomes low, and combustion stability improves. Therefore, the fall of unit power, the increase in noise, and extensive eccrisis of a still more poisonous unburnt gas can be prevented.
[0048] Although the heater 19 which heats the point of a fuel injection valve 12 was laid underground near the thin diameter section of the attaching hole 13 of the cylinder head 11 with the 1st operation gestalt of this invention mentioned above this invention is not limited to this but can acquire the same effect as the 1st operation gestalt of this invention mentioned above even if it could lay underground in the thickness of the wall of the nozzle parts 14 of a fuel injection valve 12 and constituted in this way in fuel injection valve 12 the very thing.
[0049] Next, the 2nd operation gestalt of this invention is explained with reference to drawing 6 and drawing 7 . The number same about the same component is substantially attached with the 1st operation gestalt of this invention mentioned above, and the explanation is omitted.
[0050] A heater 19 is not laid under the cylinder head 11, but it is made to build in a gas-seal member like the 1st operation gestalt mentioned above in this 2nd operation gestalt. namely, ring-like the gas seal with a heater with which the heater was built in between the circumference of the through hole of the combustion chamber side edge side of the nozzle acceptance parts 16, and level difference side 13a of the attaching hole 13 of the cylinder head 11 -- the member 24 is infixed
[0051] this gas seal with a heater -- the gas seal in the 1st operation gestalt which mentioned the member 24 above -- it consists of the seal section 25 which takes charge of the function of a

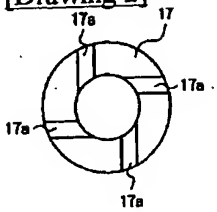
member 18, i.e., the function to prevent disclosure of the gas from the crevice between a fuel injection valve 12 and the cylinder head 11, and the heater section 26 by which heating-wire 26a was held in the interior When energized by the heater control circuit shown in heating-wire 26a of this heater section 26 at drawing 7 , a fuel injection valve 12 and the cylinder head 11 are heated.
[0052] Other composition, the flows of control by the heater control circuit, and the operation effect are the same as the 1st operation gestalt mentioned above.
[0053] However, in addition to effects, such as improvement in combustion stability, with this 2nd operation gestalt, the conventional direct cylinder-injection-of-fuel formula spark-ignition engine is received. the seal member -- the aforementioned gas seal with a heater, since it can respond only by exchanging for a member 24, there is no need of carrying out the design change of cylinder head 11 and fuel injection valve 12 the very thing and the number of parts does not increase, either An injection property and combustion stability can be improved without raising cost so much.
[0054] moreover, the gas seal with a heater of this 2nd operation gestalt -- of course, you may apply a member 24 to the 1st operation gestalt mentioned above
[0055] In addition, the operation gestalt explained above was indicated in order to make an understanding of this invention easy, and it was not indicated in order to limit this invention. Therefore, each element indicated by the above-mentioned operation gestalt is the meaning also containing all the design changes belonging to the technical range of this invention, or equal objects.

DRAWINGS

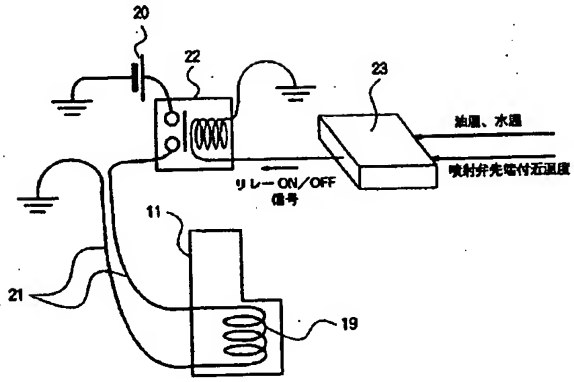
[Drawing 1]



[Drawing 2]



[Drawing 3]



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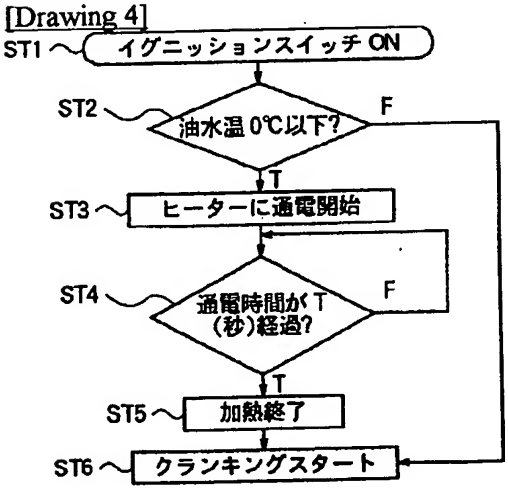
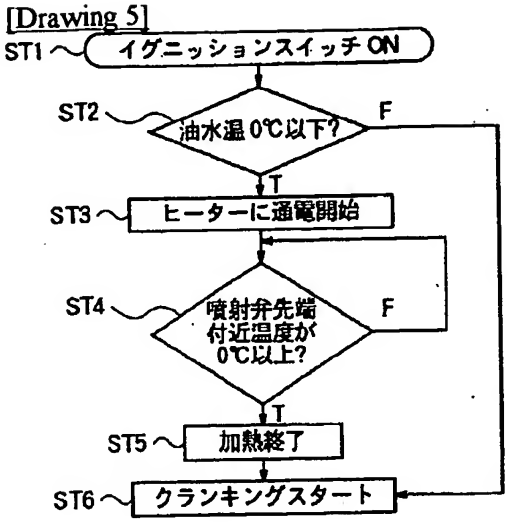


[Drawing 5]



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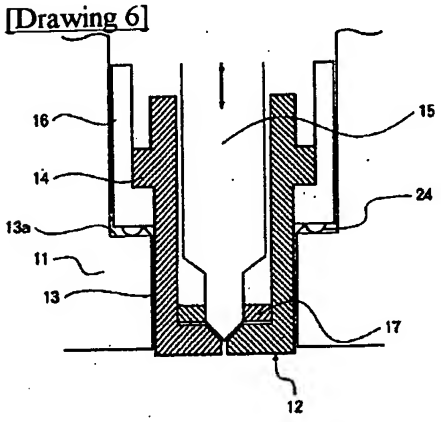
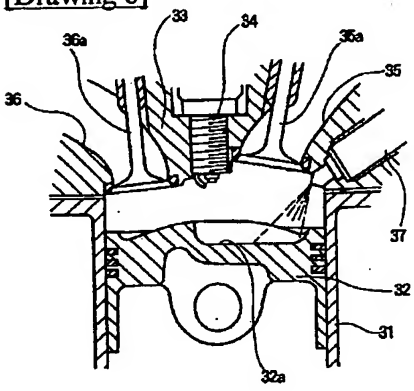
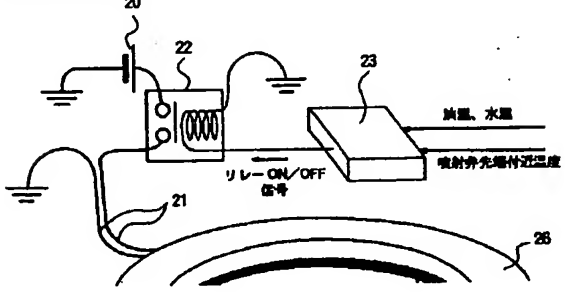


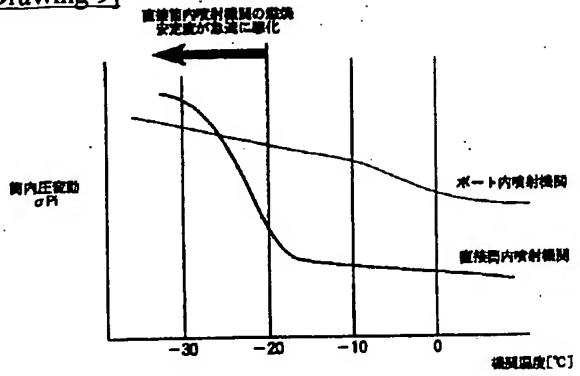
[Drawing 8]



[Drawing 7]



[Drawing 9]



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